THE EFFECTIVENESS OF GROUTING TO MINIMIZE SEEPAGE ON THE LEFT BANK OF SINDANGHEULA DAM, BANTEN PROVINCE

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Abstract

Development of Left Left Main Dam project Sindangheula Dam, Banten which is the Urugan type Dam in need of geological study with the method of Grouting consisting of 2 Blocks. This study is based on geological conditions and technical properties of rocks, especially to minimize water disaster or failure and development. Development Left Bank Of Sindangheula Dam, Banten which is the Urugan type Dam in need of geological studies with the Grouting method consisting of 2 Blocks. This study is based on the geological condition and the technical nature of the rocks, especially to minimize disaster / seepage or development failure. Based on the identification of the composition consisting of the Vitric Tuff and the LithicTuff which has a low permeability and there is a minor structure in the form of a sturdy that has orientation Southeast-Northwest and the nature of rock technique which has a RQD between 20-70% and Lugeon value between 5 -10 that fall into the category of need in Grouting and indicate that the research area is prone to disaster or water seepage so that it needs the use of Grouting method to minimize disaster. After doing the activities of Ground Trial and Cement Injection, the need to calculate the effectiveness of the use of Grouting itself in every block. Results from 2 research blocks in which each block has 1 Pilot Hole and 1 Check Hole with 3-4 stages. On Block 1 the effectiveness figure is 56.90% (Stage 1); 42.71% (Stage2); 64.40% (Stage3). On Block 2 the effectiveness figure was 31.54% (Stage1); 46.90% (Stage 2);75.13% (Stage 3). From the number of effectiveness in getting and in comparison with "The Effectiveness of Grouting and Its Effect" can be concluded that the effect of Grouting Effectiveness is Medium-Good.

Keywords: Left Bank Main Dam, Grouting, Disaster.

1. INTRODUCTION

Background

Dams are constructions built to hold water into lakes, or recreation areas. Often dams are also used to drain water to a hydroelectric power plant. In the early 20th century there was a catastrophic destruction of some dams which resulted in considerable material losses. After 1933 no large dams were constructed without geological assessment on the dam site (Varshney, 1978). Along with the need for large dams

at unfavorable locations, foundation treatment techniques have become the mainstay of being registered since 1930. Drilling technology and pressure grouting are proven to reduce seepage, minimize disasters and improve rock carrying capacity. Grouting method that was originally widely used for petroleum drilling technology, then widely applied to civil engineering. Grouting is a process, in which a liquid mixture of cement, chemicals, and water is injected with pressure into the cavities, pores, fractures and rock cracks which subsequently the liquid over time becomes physically and chemically solid.

Purpose Of Paper

The purpose of this research is to know the effectiveness of the grouting in the research area of the Left Dam Main Dam Sindangheula dam project through geological data of research area, WPT value and Lugeon value to minimize seepage / disaster.

2. LITERATURE REVIEW

Geological and Geotechnical Studies

Engineering geology, ground investigation drillings, in-situ and laboratory tests, groundwater monitoring, geophysical investigation, visual inspections and walkover surveys on site provides required data in order to evaluate ground conditions in terms of geological and geotechnical conditions of hydraulic projects. Preinvestigation, planning, final and application design stages are vital to follow (DSİ, 2016a).

Grouting

A grout consists of cement, bentonite, and various organic/inorganic chemical additives which is injected with pressure to discontinuities of rock and gaps/spaces within ground. Grouting types are explained in the following clauses.

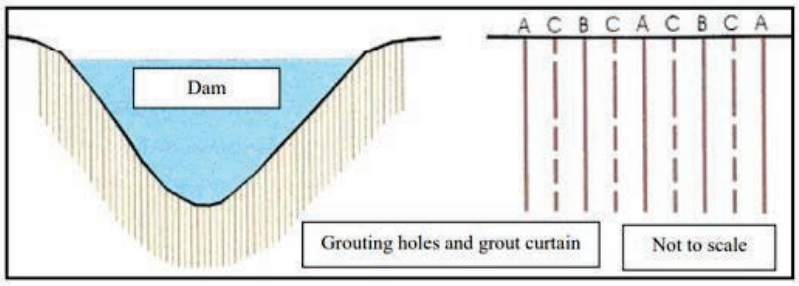

Figure 1. Schematic view of grout curtain

Trial Grouting

Grouting equipment and method, grout material, pressure of water testing and grouting are specified according to trial grouting applied on and under the ground. Laboratory tests are also conducted simultaneously. Location, layout (equilateral triangle, rhomboid, single or multi row etc.), diameter and depth of hole, grout material and material mix, water testing, refuse pressure and drilling method are decided based on the purpose, location and size of the hydraulic structure. Length between primary and final holes is generally specified based on the concept of closer and equilateral triangle methods. Grouting setting of each grout hole groups (such as primary, secondary, tertiary groups) should be waited after grouting application. It is easy to specify the required time for setting of grouting in laboratory for various mixture proportions of grout material.

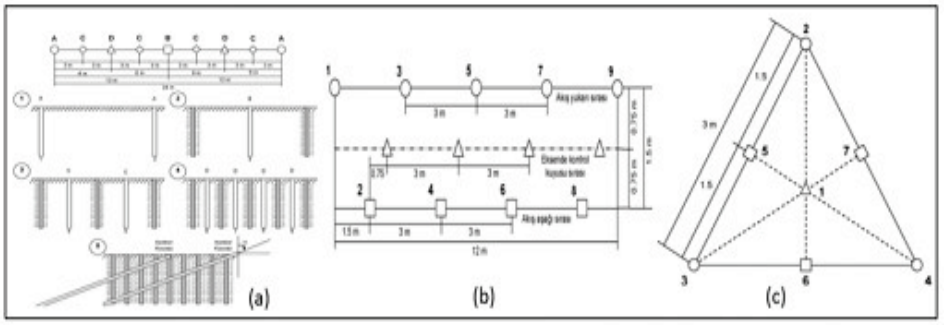

Figure 3. a) Closure grouting in single row b) Multi or several row c) Equilateral triangle methods

3. METHODOLOGY

In the early stages of research on the Left Bank Of Sindangheula Dam project in doing Stages of data retrieval. At this stage of data retrieval in doing data retrieval in the form of geology mapping of the surrounding Sindangheula Dam, core drilling data as well as data collection of water pressure test and Lugeon data. After getting the geology mapping data, core drilling data and water pressure test data and grouting data then do the stages of data processing. In the first stage of data processing is done doing geological map to know the geological conditions and make the Geotechnical Map, naming the geological unit of engineering following the level of weathering based on the analysis of material data contained in the surface and the level of weathering. In the second stage of data processing is done description of core rocks in the grouting hole to find out the location of research lithology, RQD, and its core recovery. In the third stage in determining the value of Lugeon at Left Bank of Sindangheula Dam which is Lugeon's final results will be obtained, after the gain then the next Lugeon value in connection with Grouting Needs. In the fourth stage doing a Grouting Trial, determination and description of check hole in each block and Calculation The effectiveness of the grouting implementation is inserted into the formula (Cendergren,1967). In the last stage after all the data in though, will get the geology condition of the research area on Left Bank Of Sindangheula Dam and the potential disaster area research.

4. RESULT AND DISCUSSION

Based on observations from geological mapping and geotechnical mapping, the research area of Sindangheula Dam was composed by units of Vitric Tuff, Lithic Tuff and Alluvial Deposit. There is a minor structure such fractures that have orientation Southeast-Northwest. The study area is divided into 3 Geotechnical units: Soil Unit (Soil cover), Alluvial Deposit Unit, and Fresh Tuff Rock Unit. The core drilling analysis was carried out at 3 point drill BD-11, BD-5 and BD-4 (Table 1), which aims to know the value of Rock Quality Designation (RQD), permeability coefficient value, lugeon value and to find the zone or part that has a high seepage value.

Table 1. Log Bor BD-11, BD-5 and BD-4

NO	LOG BOR	DEPTH (meter)	GROUND WATER LEVEL DEPTH (meter)	UTM COORDINATE		ELEVATION (meter)
				X	Y	
1	BD-11	40	10.41	623.067	9.316.729	119.50
2	BD-5	45	6.20	623.052	9.316.687	102.61
3	BD-4	45	10.50	623.052	9.316.657	91.15

a) BD-11

At the core drilling point BD-11 consists of Tuff stone which has a ash grain size texture, the degree of its crystallinity of hypocrystalline consisting of glass, minerals and pumice rock fragments that have a

depth of 0,2-30 meters and Welded Tuff is described which has a ash grain size texture, the degree of crystallinity of hypocrystalline which consists of glass, minerals and andesite fragments that have a depth of 30-40 meters. Based on the data from the analysis of permeability coefficient value (K) the core drilling profile is semi-impermeable and has a fairly high lugeon value ranges from 5 to 10. RQD value obtained ranging from 0 - 100% with the dominant 25 - 70%. The classification of weathering of rocks on rock / soil profiles is moderately-slightly. Based on the permeability coefficient (K), Lugeon (Lu), RQD and rocky weather levels, the rock conditions in the BD-11 drilling profile are quite bad and need to be secured by Grouting to avoid water seepage from the dam.

b) BD-5

At the core drilling point BD-11 consists of Tuff stone which has a ash grain size texture, the degree of its crystallinity of hypocrystalline consisting of glass, minerals and pumice rock fragments that have a depth of 2-21 meters and Welded Tuff is described which has a ash grain size texture, the degree of crystallinity of hypocrystalline which consists of glass, minerals and andesite fragments that have a depth of 21-45 meters. Based on the data from the analysis of permeability coefficient value (K) the core drilling profile is semi-impermeable and has a fairly high lugeon value ranges from 3 to 8. RQD value obtained ranging from 0 - 100% with the dominant 35 - 75%. The classification of weathering of rocks on rock / soil profiles is moderately-slightly. Based on the permeability coefficient (K), Lugeon (Lu), RQD and rocky weather levels, the rock conditions in the BD-5 drilling profile are quite bad and need to be secured by Grouting to avoid water seepage from the dam.

c) BD-4

At the core drilling point BD-11 consists of Tuff stone which has a ash grain size texture, the degree of its crystallinity of hypocrystalline consisting of glass, minerals and pumice rock fragments that have a depth of 2-11 meters and Welded Tuff is described which has a ash grain size texture, the degree of crystallinity of hypocrystalline which consists of glass, minerals and andesite fragments that have a depth of 11-45 meters. Based on the data from the analysis of permeability coefficient value (K) the core drilling profile is semi-impermeable and has a fairly high lugeon value ranges from 3 to 10. RQD value obtained ranging from 0 - 100% with the dominant 10 - 80%. The classification of weathering of rocks on rock / soil profiles is slightly. Based on the permeability coefficient (K), Lugeon (Lu), RQD and rocky weather levels, the rock conditions in the BD-4 drilling profile are quite bad and need to be secured by Grouting to avoid water seepage from the dam.

After knowing the geology profile of the research area through geological mapping, the RQD value, the permeability coefficient value and the weathering classification were carried out in a grouting experiment with cement injection consisting of 2 blocks and each block having 1 pilot hole. After the grouting trial has been completed then done the water pressure test on check hole in each block to know the value of Lugeon after grouting. After the value of Lugeon already in get then do the calculation of the effectiveness of grouting.

Table 2. Efectiveness Grouting

LUGEON	BLOCK 1	BLOCK 2
STG-1	56.90%	31.54%
STG-2	42.71%	46.90%
STG-3	64.40%	75.13%

Table3. Effectiveness of Grouting and Indicator

Effectiveness of Grouting	Indicator
>90	Very Good
60-90	Good
30-60	Medium
10-30	Bad
<10	Very Bad

5. CONCLUSION

From the research that has been done on the left bank Sindangheula main dam, Banten Province, it can be concluded that:

1) The correlation of geological profile and stratigraphy of research consists of Tuff stone, welded tuff and soil clay which has slightly-moderately weathering, structure minor in the research area is in the form of fracture and seen from the correlation of Lugeon value in the research area, it is concluded that the research area is a zone that has permeability or high seepage where the potential for disaster or development failure is very possible.
2) After getting the Lugeon value in the research area where the urugan dam type is proposed, it is suggested that in doing the Grouting or cement injection to minimize disaster or water seepage and reinforce the foundation itself.
3) After doing Grouting Lugeon value in the research area has decreased. In doing the calculation of Effectivenss Grouting which has medium-good indicator.

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